Chapter 3
Calendars, the Time of Day and Mathematical Astronomy

Calendars

In the Yemen there is a variety of calendars used in the countryside varying much from region to region, but all based on the observation of stars. This has given rise to a not inconsiderable literature showing the correspondences between calendars, and of almanacs which specify the appropriate agricultural labours to be undertaken in their seasons.

The *hijrah* year which in this book is given along with the corresponding date in the Christian era is of course common to all regions for official and religious purposes. Being a lunar year it is not used for dating seasonal events and operations.

Instead the Byzantine/Greek months (*al-shuhūr al-Rūmiyyah*) are in common use in the north and even as far south as Lahej on the Aden side of the border. Al-Hamdānī[1] dates agricultural operations such as sowing or harvesting by this system which, writing about the very early 4th/10th century, he treats as well enough established to need no comment. True to their name they were undoubtedly introduced from Byzantium into southern Arabia before Islam, probably by the Christians in the Yemen. My impression is that they are not used east of a line as yet undetermined, but which it would be interesting to plot. In almanacs the corresponding stars are noted for each *Rūmī* month. It is stated[2] that the agricultural year begins on the 1st of Shubāṭ, i.e., 14 March, but the normal order of these months is

Tishrīn al-Awwal, 14 October	Naysān/Nīsān
Tishrīn al-Thānī	Ayyār or Mabkar
Kānūn al-Awwal	Ḥazīrān
Kānūn al-Thānī	Tammūz
Shubāṭ	Āb
Ādhār	Aylūl[3]

The third type is the star calendar universal in the Arab world, even as far west as medieval Arab Spain, the Yemen version of which was first published by Glaser upon whose researches the table below is based. The star calendar however varies widely from place to place both in nomenclature and periodicity, though local calendars appear to be related to the system in the table.

Month	Day	Sun-Stations	Agricultural Stars	Evening Ascension	Morning Ascension
January	10	*Sa'd al-Dhābiḥ*	*Rābi' Awwal* (Evening)	*al-Nathrah*	*al-Na'ā'im*
	23	*Sa'd Bula'*	*Rābi' Ākhir* (Evening)	*al-Ṭarf*	*al-Baldah*
February	5	*Sa'd al-Su'ūd*	*Khāmis al-Ṣawāb*	*al-Jabhah*	*al-Dhābiḥ*
	18	*Sa'd al-Akhbiyah*	*Sādis al-Ṣawāb*	*al-Zabrah*	*Sa'd Bula'*
March	3	*al-Fargh al-Muqaddam*	*Sābi' al-Ṣawāb*	*al-Ṣarfah*	*Sa'd al-Su'ūd*
	16	*al-Fargh al-Mu'akhkhar*	*Ẓafir Awwal*	*al-'Awwā*	*Sa'd al-Akhbiyah*
	29	*Baṭn al-Ḥūt*	*Ẓafir Thānī*	*al-Simāk*	*al-Muqaddam*
April	11	*al-Sharaṭayn*	*Simāk (al-Far')*	*al-Ghufr*	*al-Mu'akhkhar*
	24	*al-Buṭayn*	*Ghurūb Kāmah*	*al-Zubānā*	*al-Risha (Baṭn al-Ḥūt)*
May	7	*al-Thurayyā*	*Ghurūb al-Thawr*	*Iklīl*	*al-Sharaṭayn*
	20	*al-Dabarān*	*Ṭulū' Kāmah*	*al-Qalb*	*al-Buṭayn*
June	2	*al-Haq'ah*	*Ṭulū' al-Thawr*	*al-Shawlah*	*al-Thurayyā*
	15	*al-Han'ah*	*Ṭulū' al-Ẓulm al-Awwal*	*al-Na'ā'im*	*al-Dabarān*
	28	*al-Dhirā'*	*Ṭulū' al-Ẓulm al-Thānī*	*al-Baldah*	*al-Haq'ah*
July	12	*al-Nathrah*	*'Alīb*	*Sa'd al-Dhābiḥ*	*al-Han'ah*
	25	*al-Ṭarf*	*Suhayl*	*Sa'd Bula'*	*al-Dhirā'*
August	7	*al-Jabhah*	*Rawābi' Awwalah*	*Sa'd al-Su'ūd*	*al-Nathrah*
	20	*al-Zabrah*	*Rawābi' Akhirah*	*Sa'd al-Akhbiyah*	*al-Ṭarf*
September	2	*al-Ṣarfah*	*Khāmis 'Allān*	*al-Fargh al-Muqaddam*	*al-Jabhah*
	15	*al-'Awwā*	*Sādis 'Allān*	*al-Fargh al-Mu'akhkhar*	*al-Zabrah*
	28	*al-Simāk*	*Sābi' 'Allān*	*Baṭn al-Ḥūt*	*al-Ṣarfah*
October	11	*al-Ghufr*	*Awwal Fīr'*	*al-Sharaṭayn*	*al-'Awwā*
	24	*al-Zubānā*	*Rabī' Kāmah* (Evening)	*al-Buṭayn*	*al-Simāk*
November	6	*al-Iklīl*	*al-Thawr* (Evening)	*al-Thurayyā*	*al-Ghufr*
	19	*al-Qalb*	*al-Najmayn* (Evening)	*al-Dabarān*	*al-Zubānā*
December	5	*al-Shawlah*	*Ẓulm Awwal* (Evening)	*al-Haq'ah*	*al-Iklīl*
	15	*al-Na'ā'im*	*Ẓulm Thānī* (Evening)	*al-Han'ah*	*al-Qalb*
	28	*al-Baldah*	*Suhayl* (Evening)	*al-Dhirā'*	*al-Shawlah*

Rossi[4] confirms that Ṣan'ā' distinguishes four seasons of the year - *Shitā'* winter, *Rabī'* spring, *Ṣayf* summer, and *Kharīf* autumn. A Ms. source says that winter begins on 24 Aylūl which should be 6 October, spring on 24 Kānūn, summer on 24 Ādhār, and autumn on 24 Ḥazīrān, but I have not checked to see if these are the accepted dates in present day Ṣan'ā' though it is likely. For the peasants of the Ṣan'ā' plain Rossi gives *Qiyāḍ* the late winter harvest, *Dithā'* the harvest of spring-summer, *'Allān*[5] the season of rains, and *Ṣurāb* the autumn harvest. *Al-Ṣaḥr* is a hot period falling about late May, June and July—it would appear to vary in its incidence: *Sabt al-Subūt*[6] in the northern Yemen is said to be the Saturday, falling in October, which marks the beginning of winter.

The past year, says Qāḍī Ismā'īl, is called *al-'ām* among the tribes of Dhamār and Yarīm, and the year before it *qabl al-'ām*. In everyday speech people naturally date by events, such as before or after the 'Īd, either of the two Feasts, but especially by al-'Īd al-Kabīr, the Feast of the Sacrifices, etc.

It would be possible to say much more about calendars in the

1 Al-Hamdānī, *Sifah*, ed. D. H. Müller, 199.
2 In Muḥammad Ḥaydarah's almanacs published at Ta'izz, but this may not be true for other parts of the Yemen.
3 See 'Cultivation of cereals in Medieval Yemen', *Arabian Studies*, Cambridge-London, 1974, 28 seq., and 61 seq., passim; 'Star calendars and an almanac from south-west Arabia', *Anthropos*, Posieux (Fribourgh), 1954, XLIX, 433-59; A M A Maktari, *Water rights and irrigation practice in Lahj*, Cambridge, 1971, 177. These contain earlier bibliography.
4 *L'Arabo parlato*, 151.
5 This for Rossi's 'Allām.
6 Sabt al-Subūt in Zabīd comes about the end of the date season. Cf. 'Abd al-Raḥmān 'Abdullāh al-Ḥaḍramī, 'al-Mu'arrikhūn wa-Subūt fī Zabīd', *al-Kalimah*, Hodeidah, 1973.

Yemen and Ṣan'ā' district in particular, as, also, the popular wisdom and lore connected with them. A knowledge of them is essential to any enquiry into the life of the villages surrounding Ṣan'ā', and even into life in Ṣan'ā' itself[7].

In Ṣan'ā' Arab time is commonly used, though persons and institutions dealing with foreigners also use the western reckoning. Thus western 6 a.m. is 1 o'clock and 12 noon 6 o'clock Arab time. The Arab day commences at 6 p.m. Western time, so that, e.g., an Arab referring to the evening of Friday means a period commencing at our 6 p.m. on Thursday. The Muslim calendar is therefore reckoned by nights, but the *Rūmī* calendar on the contrary by days, since it is the daytime which starts first.

The Times of Day in the Upper Yemen

In olden times the Yemeni did not use a watch, but distinguished the various times of day by names of their own. The list of these below was provided by Qāḍī Ismā'īl. Though, as elsewhere in the Peninsula, Arab time is ordinarily in use, in the larger towns of the Yemen concessions have been made to European time reckoning.

1) *Sharqat al-shams* or *fadhdhat*[8] *shams* (Class. *al-shurūq*), sun-rise.
2) *Kharjat ghanam* or, with the tribes, *masraḥ qurāsh,* the going out (to pasture) of the sheep-and-goats, or the morning departure of cattle/beasts.
   Waqt al-'ajīn, kneading time (for the breakfast bread), with women.
   Class. *al-bukūr.*
3) *Ḥamyat*[9] *shams,* or *ḥamyat al-kilāb,* or simply *ḥamyah* (Ṣan'ā'), the warmth of the sun, or *ṭarḥat shams,* when the sun's rays fall on the earth straight down.
   Class. *al-ghuduww.*
4) *Rakzat shams* (Class. *al-ḍuḥā*), high morning, from about 9 to after 11 a.m., used by the tribes particularly.
5) *Waqt al-waqdah/al-waqīd* (Class. *al-hājirah*); Ṣan'ā', *al-laṣyah*; Dhamār, *al-luṣwah,* fire-lighting time (for making the lunch bread), used among women and the tribes; in Ṣan'ā' and Dhamār—firewood (time).
6) *Waqt al-ẓuhr* (Class. *al-ẓahīrah*), or *al-ghadā',* or, in Ṣan'ā', *adhān al-ẓuhr,* midday, or lunch, or the midday call to prayer. Described as *kabid al-samā',* the meridian of the sky.
7) *Ba'd al-ẓuhr,* or *bayn al-ṣalātayn,* or *bayn al-'aṣrayn,* (Class. *al-rawāḥ*), afternoon, or, between the two prayers, or, between the two afternoon periods.[10] *Qahwat ghadā',* lunch coffee-time, with women.
8) *'Aṣr* (also Class.), mid-afternoon.
   Tafriṭah, with women—women's leisure time.[11]
9) *Ba'd al-'aṣr* (Class. *al-qaṣr*), late afternoon, the last part of the day.
10) *Raj'at ghanam*[12] (Class. *al-aṣīl*), return of the sheep-and-goats—with the tribes.
11) *Qabl al-maghrib* (Class. *al-ghurūb*), before sunset, setting of the sun.
12) *Gharbat shams,* or *ghaybah* (Class. *al-'ashiyy*), sunset.[13]
13) *Ba'd al-maghrib* (Class. *al-shafaq*),[14] after sunset.
14) *'Ishā'* (Class. *al-ghasaq*)[15] evening, or *Ṣalāt al-'ishā',* evening prayer.
15) *Ba'd al-'ishā',* or *al-dānī,* after evening, or, the near.
16) *Ḍarbat al-marfa',* or *al-tamsiyah* (time equivalent to Class. *al-sudfah*), the beating of the drum. The verb *massā, yimassī,* obviously to be derived from the Arabic *masā',* evening, means to beat the drums (*ṭubūl*) at 3 o'clock Arabic time, i.e. 9 p.m. This is to announce the curfew which appears to be an ancient institution and to be indicated in a passage of al-Rāzī's[16] history.
17) *Haj'ah* (Class. *al-faḥmah*),[17] quiet, stillness of people and sleeping.
18) *Nuṣṣ al-layl* (Class. *al-zullah*), middle of the night.
19) *Ghadā Ramaḍān,* or *saḥūr,* or *al-tasbīḥat al-awwalah* (Class. *al-zulfah*),[18] Ramaḍān breakfast, breakfast, or, the first *tasbīḥah,*[19] collect.
20) *Al-tasbīḥat al-thāniyah* (Class. *al-ṣubḥah*), the second *tasbīḥah,* collect.
21) *Al-taḥmīdah,* or *al-tasbīḥat al-thālithah,* the third collect. At time of Class. *al-saḥar,* before daybreak.
22) *Al-fajr,* dawn.
23) *Ḍaw',* or *ḍaw' ẓalām,* or *ghabash* (Class. *al-ṣubḥ*), light before sun-rise, of last shadows of the night, etc.
24) *Ziqziqah,* or *ḍaw' barāḥ* (*al-ṣabāḥ*), bird-chirping[20] (sparrow-fart!), the light of a veiled woman uncovering her face (*kashf ḍaw' sāfir 'an wajhi-hā*)!

Festivals

'Id al-Mawlid al-Nabawiyy, the Prophet's birthday—12 Rabī' I.
'Id al-Naṣr, the Victory Festival, when Imām Aḥmad defeated 'Abdullāh al-Wazīr[21]—28 Jumādā I.
'Id Jum'at Ṣan'ā', when the people of Ṣan'ā' accepted Islam, after which all the Yemen followed them—First Friday of Rajab.
Al-'Id al-Ṣaghīr/'Id al-Fiṭr, the Lesser Festival—1 Shawwāl.

7 This is evident from the Ms. of which I have a photocopy through the kindness of the Shaykh Muḥammad Zayd, containing much agricultural material, notably a poem of Ḥasan b. Jābir al-'Affāri. This Ms. of mixed contents I have under examination at present. The Islamic calendar also has numerous sayings and saws connected with it, e.g., *'al-'ashr marḥūmah wa-lā fi'l-shitā',* the ten days of Dhu'l-Ḥijjah are fortunate even if they fall in winter.' They are fortunate (*marḥūmah* = *khayyirah*) because things for the 'Id are plentiful.

8 Paraphrased as *waqt shurūq-hā.* One says *Min ayn fadhdh? = ashraqat,* imperfect *tafudhdh.*

9 *Ḥamyah* = *al-dif', Ṭarḥah,* when the rays fall on the earth *murakkazah.*

10 Between Ṣalāt al-Ẓuhr and al-'Aṣr.

11 *Tafruṭah/tafriṭah,* pl. *tafārit, when women attend a wedding* ('*irs*) or a birth (*wilādah*) or more precisely perform the visits connected with these events, or it may be a rather different occasion, *al-mawt,* a death, where they wear black (*thiyāb sūd*), the mourners rearing their hair, slapping their faces, and mentioning the deceased father or husband. A woman might say to her husband, *'Shāsīr aṭfarraṭ 'ind bayt filān'* not mentioning the name of the woman she intends to visit; or she might mention the name of the woman, were she among women only. Compare the expression *'Shatla' aṭjamma' 'ind ummī,* I'm going to spend Friday with my mother'. What at first sight seems a strange expression is reported of San'ānī women not of the upper classes—one of these would say, *'Shāsir 'ind istīmat al-Malik/al-Raḥmān'* etc. This is probably for *sitti Amat,* there being many female names of the type Amat al-Razzāq, Amat al-Laṭīf, etc.

12 See p. 169b seq.

13 About now in Ramaḍān, *Iftār al-ṣā'im,* faster's breaking his fast.

14 Remains of light and redness of the sun in the first part of the night (Lane). Aḥmad al-Shāmī calls it *bayn maghrib wa-'ishā'.*

15 Class. *'atamah,* first third of the night after the disappearance of *al-shafaq.*

16 Cf. p. 148a, n. 46. The *ḥaras al-layl* assemble and chant *zawāmil.*

17 *Faḥmah,* the intense dark of the night.

18 A portion of the first part of the night (Lane).

19 The *tasbīḥah* is said to include such phrases as *Subḥān Allāh*; texts are given on pp. 310b seq. In Ramaḍān *yusabbiḥ al-mu'adhdhin* three times during the night. The third called *taḥmīdah* is said to be different from the first two and somewhat longer. Al-Shawkānī, *al-Badr al-tāli'*, Cairo, 1348 H, II, 101, relates that a fanatic in the early days of al-Mahdi 'Abbās, averred that he rose in revolt because he found that in his first times in Ṣan'ā' the muezzins used to make three *tasbīḥahs* at the end of the night, then when he entered Ṣan'ā' again he found they had grown lax, and some only made two, some one, and some no *tasbīḥah* at all!

20 *Waqt zaqzaqat al-'aṣāfīr,* the time when sparrows break into chirping at dawn.

21 No longer celebrated of course.

Yawm al-Ghadīr, the Shī'ī festival of Ghadīr Khumm when the *tamshiyat Yawm al-Ghadīr* takes place, also called al-Nushūr[22]—'Id 'Arafah = 9 Dhu 'l-Ḥijjah.
Al-'Id al-Kabīr called al-Iḍḥā (Aḍḥā), the Feast of the Sacrifices—10 Dhu 'l-Ḥijjah.

Mathematical Astronomy in Medieval Yemen

There has been an active tradition in mathematical astronomy in the Yemen from the 4th/10th century down to the present century. This tradition is attested by several dozen medieval astronomical manuscripts of Yemeni provenance that have been located in the past few years in various libraries in Europe and the Near East.[23] The scope of the surviving Yemeni astronomical writings suggests that other works were compiled by the astronomers of medieval Yemen that are now no longer extant.

The Yemeni tradition of mathematical astronomy is quite distinct from the tradition of folk astronomy attested in the Yemeni almanacs described above. This folk astronomy relates the seasons, whose passage is determined by the progress of the sun along the ecliptic, to agricultural and meteorological patterns. Medieval mathematical astronomy, on the other hand, was concerned with such topics as the determination of the positions of the sun, moon, planets, and the fixed stars; the prediction of planetary conjunctions, eclipses, and visibility of the lunar crescent; timekeeping by the sun and stars; and the computation of horoscopes and celestial configurations with astrological significance. The Islamic tradition of mathematical astronomy was based on the earlier traditions of Greek, Sasanian, and Indian astronomy, rather than the primitive folk astronomy of the Arabian Peninsula. Since only a very small fraction of the works compiled by Muslim astronomers was known in medieval Europe, most of the vast corpus of Islamic astronomical literature has only become known in the West during the past 150 years, as a result of the labours of orientalists working in the libraries where this heritage is in part preserved. This literature includes *zīj*, that is, astronomical handbooks containing extensive tables and instructions for solving the standard problems confronting the medieval astronomer; tables for timekeeping by the sun and stars and for regulating the times of prayer, which in Islam are astronomically defined; treatises on instruments; treatises on astrology; and treatises on a wide range of other related topics.[24]

The earliest Yemeni astronomer on whom we have some reliable information is the celebrated late 4th/10th century geographer al-Hamdānī. He compiled a *zīj* which was used in the Yemen at least until the 7th/13th century. Unfortunately this *zīj* is no longer extant, but we know from a surviving fragment of al-Hamdānī's treatise on mathematical astrology that he was familiar with the earlier *zīj* of the astronomers of 'Abbāsid Iraq. Most of these works are likewise lost, and it is a complicated task for the historian of Islamic science to gather information on these works from such valuable sources as al-Hamdānī's chapter in his treatise on astrology dealing specifically with the different opinions of his predecessors.

Under the Rasūlid Sultans there was considerable activity in astronomy in the Yemen, some of which was conducted by the Sultans themselves. The two astronomers al-Fārisī and al-Kawāshī were apparently sponsored by the Sultan al-Muẓaffar. Al-Fārisī prepared a *zīj* containing tables for the Yemen, based on a 6th/12th century Iraqi *zīj*, and al-Kawāshī prepared a *zīj* with tables specifically for Aden and Ta'izz, based mainly on a contemporary Egyptian *zīj*. The Sultan al-Ashraf himself compiled an extensive treatise on astrolabes and sundials, displaying his knowledge of certain earlier Andalusian and Egyptian works on these instruments. He compiled new tables for drawing the curves on astrolabes and sundials, computing these tables for the latitudes of the major cities of the Yemen. One of the astrolabes made by al-Ashraf with the aid of these tables is now preserved in the Metropolitan Museum of Art in New York. Al-Ashraf also compiled an extensive treatise on astrology, in which he included astrological tables computed specifically for the latitude of Ṣan'ā'.

The Yemeni astronomer Abu 'l-'Uqūl worked for the Sultan al-Mu'ayyad. He compiled a *zīj* based on one of the *zījes* of the 4th/10th century Cairo astronomer Ibn Yūnus, and included tables computed specifically for the latitudes of Aden, Ta'izz, Zabīd, and Ṣan'ā'. Greater originality is displayed in the corpus of tables for timekeeping attributed to Abu 'l-'Uqūl. These tables for timekeeping by the sun and stars, computed for the latitude of Ta'izz, constitute the largest known corpus of such tables compiled for any Islamic city during the medieval period, being considerably more extensive than the corresponding tables that were prepared for such centres of astronomy as Cairo and Damascus. In fact, the Ta'izz corpus contains over one hundred thousand entries, but it is difficult to estimate the extent to which these tables were used in later centuries since they survive in only two manuscripts, whereas literally dozens of manuscripts of the Cairo and Damascus tables survive. No comparable corpus of tables for timekeeping appears to have been compiled for Ṣan'ā'.

Each year almanacs and ephemerides were prepared for the Yemeni Sultans by their astronomers. These contained extensive calendrical and astrological information for the year in question, as well as tables of the positions of the sun, moon, and planets for each day of the year. Two of these survive in the manuscript sources, both now preserved in the Egyptian National Library in Cairo. The first was prepared for Ṣan'ā', 727/1326-7, and the second for Ta'izz, 808/1405-06.

The Sultan al-Afḍal compiled an extensive compendium of astronomical treatises and tables, most of which were simply lifted from earlier Egyptian, Syrian, and Yemeni sources. Such a compendium is of considerable interest to historians of science for the information it contains on earlier works that are no longer extant in their original form. Various other Yemeni works of an eclectic nature survive either complete or in fragmentary form in the manuscript sources and remain to be properly studied, including *zīj* for Ṣan'ā', Zabīd, and Ta'izz. The last Yemeni *zīj* tables were compiled for Ṣan'ā' in the 11th/mid 17th century by the brothers al-Ḥasan and 'Abdullāh al-Sarḥī, relying entirely on earlier Yemeni *zīj*. In Ṣan'ā' today there is still a small group of elderly people who have received instruction on the *zīj* of the brothers al-Sarḥī.

Besides this sophisticated tradition of mathematical astronomy the Yemeni astronomers maintained an interest in traditional folk astronomy and simple timekeeping using shadow lengths by day and the lunar mansions by night. Thus, for example, the 7th/13th century astronomer al-Fārisī wrote a treatise on these two topics as well as his *zīj*. In the courtyard of the mosque of al-Janad north of Ta'izz there is a stone gnomon about the height of a man, with which the time of day could be reckoned using

22 On this day Imām Yaḥyā used to go out to 'Ayn al-Faqīh or Khazā' in al-Muṭahhar or Lakamat al-Jazzārīn, the last being on the footslopes of Nuqum to the east of it and Ṣan'ā'.

23 For a more detailed account of Yemeni astronomy see D. A. King, *Mathematical astronomy in medieval Yemen*, currently being submitted for publication.

24 For a brief account of Islamic astronomy see D. Pingree's article "Ilm al-hay'a' in *EI*². Additional basic information on Islamic astronomy is contained in the *Encyclopaedia* articles *Astronomy*, *Manāzil* (lunar mansions), *Mawāqīt* (definitions of the prayer-times), *Minṭaqa* (zodiac), and *Ṭasyīr* (aspects of mathematical astrology) in the 1st ed.; and *Asṭurlāb* (astrolabe) and *Ḳibla* (direction of Mecca) in the 2nd. ed.
On Islamic astronomical handbooks and tables see E. S. Kennedy, 'A Survey of Islamic astronomical tables,' *Transactions of the American Philosophical Society*, Philadelphia, n.s., XLVI, 1956, 123-177, and D. A. King 'On the astronomical tables of the Islamic Middle Ages', *Studia Copernicana*, XIII, Wrockaw, 1975, 37-56.

simple rules originally adopted from Indian astronomy, and the time of the midday and afternoon prayers, both defined in terms of shadow lengths, could also be regulated. In medieval Yemeni almanacs simple tables were sometimes given for reckoning time of night by the lunar mansions.

In the Yemen, as elsewhere in the Islamic world, mathematical astronomy declined from about the 9th/15th century onwards. The works of the early Yemeni astronomers were thereafter forgotten and in some cases lost. Fortunately, enough Yemeni manuscripts survive in libraries in Europe and the Near East to enable us to document a substantial part of this tradition for the first time.